The human brain and the central nervous system develop early during embryogenesis. This complex process involves many changes that occur within a week. Which of the following statements about the development of the brain is correct?

A. All of the development of the brain is complete by the 4th week, including the development of the cerebral hemisphere.
B. As development proceeds, the diencephalon will give rise to the pons.
C. The developing choroid plexus will eventually give rise to the pons.
D. By the 4th week of development, the distinct brain vesicles lead to the formation of the telencephalon and the diencephalon.
E. By the 8th week of development, the mesencephalon is complete.

Feedback

A. Incorrect!
The cerebral hemisphere, or telencephalon, has developed by the 11th week of embryological development.

B. Incorrect!
The metencephalon will give rise to the pons.

C. Incorrect!
The developing choroid plexus will be part of the ventricular system of the brain, which contains the CSF.

D. Correct!
By the 4th week of development, the distinct brain vesicles lead to the formation of the telencephalon and the diencephalon.

E. Incorrect!
The mesencephalon is completed after 11 weeks.

Solution

Prior to the closure of the neural tube, the initial cephalic expansions occur during brain development. By 4 weeks of development (28 days), the distinct brain vesicles, through subdividing, lead to the formation of the: Telencephalon, Diencephalon, Mesencephalon, Metencephalon, and the Myelencephalon. By 8 weeks of development, the meninges are developing and the blood vessels begin to form the choroid plexus. The choroid plexus will eventually be part of the ventricular system of the brain where the cerebral spinal fluid (CSF) is produced. By 11 weeks of development, the telencephalon (cerebral hemisphere) has developed. Eventually, as development progresses, the mesencephalon will be comprised of the tectum and cerebral peduncles and be joined with the metencephalon, also known at this stage as the pons.
### Question No. 2 of 10

**Instructions:** (1) Read the problem statement and answer choices carefully, (2) Work the problems on paper as needed, (3) Pick the answer, and (4) Review the core concept tutorial as needed.

Which lobe of the brain is identified in the image below?

- A. Occipital
- B. Parietal
- C. Pons
- D. Temporal
- E. Frontal

**Feedback**

A. Incorrect!
The occipital lobe is at the back of the brain.

B. Correct!
The parietal lobe is identified in the image.

C. Incorrect!
The pons is part of the brainstem.

D. Incorrect!
The temporal lobe is located on either side of the brain, below the parietal lobe.

E. Incorrect!
The frontal lobe is located at the anterior portion of the brain; the parietal lobe is identified in the image.

**Solution**

The human brain is organized into 2 hemispheres, and each hemisphere is further divided into a number of lobes: (A) Frontal lobe, (B) Temporal lobe, (C) Parietal lobe and (D) Occipital lobe. The brain weighs approximately 1.4 kg or 3 lb. and has an approximate volume of 1350 cc.
Deep inside the brain is the diencephalon. This brain region is located superior to the mesencephalon, or midbrain, and plays a key role in emotions and hormone production. Which of the following statements about the diencephalon is correct?

A. The diencephalon has 4 major divisions: epithalamus, thalamus, hypothalamus, and the pons.
B. The thalamus functions as a sensory processing center.
C. The pituitary gland is located in the thalamus.
D. The diencephalon is also known as the midbrain.
E. The diencephalon has no role in the autonomic nervous system.

A. Incorrect!
The diencephalon has three major divisions: epithalamus, thalamus and the hypothalamus.

B. Correct!
The thalamus is located one on both the left and right side, and they function as sensory processing areas.

C. Incorrect!
The pituitary gland is located within the diencephalon, specifically in the floor of the diencephalon near the hypothalamus.

D. Incorrect!
The mesencephalon is also known as the midbrain.

E. Incorrect!
The diencephalon functions as a sensory processing area and as a visceral control center in emotions, hormone production and autonomic nervous system function.

The diencephalon has three major divisions: (1) epithalamus – contains the pineal gland, (2) thalamus – are on both the left and right side, and they function as sensory processing areas, and (3) floor of the diencephalon – the hypothalamus and the pituitary gland. The hypothalamus functions as a visceral control center. The hypothalamus is involved in emotions, hormone production and autonomic nervous system function.
A 28-year-old man is treated in the emergency room for a blunt force injury to the right side of his skull. The emergency room doctor notes that the injury has damaged the patient’s cranium and dura mater at the injury site. Based on this information, which of the following would be correct?

A. In addition to the damage to the skull bone, the outer layer of the meningeal covering of the brain was damaged in this injury.
B. The layer of the meninges that is in contact with the brain tissue directly was noted to be damaged in this patient.
C. The arachnoid matter must also have been damaged in this injury because it lies between the dura mater and the bone of the skull.
D. The blood supply to the region of the brain at the injury site would be compromised, as it normally lies within the dura mater.
E. The injury suffered by this patient damaged one of the 5 meningeal layers of protection for the brain.

A. Correct! The dura mater is the outer layer of the meninges.
B. Incorrect! The pia mater is the layer in direct contact with the brain tissue; this patient injured the outer layer (dura mater).
C. Incorrect! The arachnoid mater lies between the dura mater and the pia mater.
D. Incorrect! The blood supply that supports the major vessels of the brain is located within the pia mater.
E. Incorrect! There are 3 meningeal layers: dura mater, arachnoid mater and the pia mater.

The outermost covering of the brain is the dura mater. This is a tough, fibrous covering, which is made up of dense, irregular connective tissue within layers of simple squamous epithelium. The dura mater contains the cerebral spinal fluid within the central nervous system. The dura mater is attached to the skull, the first and second cervical vertebrae, and the posterior longitudinal ligament. The arachnoid mater is located between the outer dura mater and the inner pia mater. Between the arachnoid mater and the pia mater is the arachnoid space in which the cerebral spinal fluid is contained. The pia mater is the delicate, innermost layer protecting the brain. Within the elastic and collagen fibers of the pia mater is the blood supply that supports the large cerebral vessels.
### Question #05

The brain and spinal cord are bathed in a unique fluid, known as cerebral spinal fluid. The fluid has a number of important functions within the central nervous system. Which of the following statements about cerebral spinal fluid is correct?

A. The short form for cerebral spinal fluid is SCF.
B. Cerebral spinal fluid is produced near the thoracic region of the spinal cord and then it circulates within the subarachnoid space.
C. In addition to cushioning the brain from forces applied to the skull, the cerebral spinal fluid also transports nutrients and oxygen to brain tissue.
D. The specialized ependymal cells of the brain degrade the excess cerebral spinal fluid produced elsewhere.
E. The volume of CSF produced daily is approximately 50 mL.

### Feedback

A. Incorrect!
The short form for cerebral spinal fluid is CSF.

B. Incorrect!
Cerebral spinal fluid is produced within the ventricular system of the brain by the ependymal cells.

C. Correct!
CSF functions by providing protection for the brain, transporting nutrients and oxygen, as well as chemical messengers.

D. Incorrect!
The specialized ependymal cells produce cerebral spinal fluid in the ventricular system of the brain.

E. Incorrect!
Approximately 500 mL/day of CSF is produced.

### Solution

The cerebral spinal fluid (CSF) functions to separate the brain tissue and the surrounding bones of the skull. The CSF also cushions the brain from movement and forces applied to the skull, and it transports nutrients, chemical messengers and oxygen to the different regions of the brain. Within each ventricle is a choroid plexus, which is a combination of specialized ependymal cells and highly permeable capillaries. The ependymal cells use both active and passive transport to produce and secrete CSF into the ventricular system of the brain. CSF is produced at a rate of approximately 500 mL/day. The flow of CSF is as follows: from the aqueduct of the midbrain, then through the lateral apertures into the subarachnoid space.
One of the major barriers of protection of the human brain is the blood-brain barrier. In addition to the bones of the skull and the meningeal coverings, the blood-brain barrier also protects the brain, specifically from drugs and compounds inside the body. Which of the following statements about the blood-brain barrier is correct?

A. The spaces between the endothelial cells in the blood vessels of the brain are larger than those elsewhere in the body.
B. There are regions in the brain that normally have a decreased blood-brain barrier, such as portions of the hypothalamus.
C. The entire brain has a continuous blood-brain barrier.
D. The blood-brain barrier prevents the passage of small hydrophobic molecules, such as oxygen, to enter the brain tissue.
E. The tightly-packed endothelial cells in the blood vessels of the brain are surrounded by neurons and, together, these make up the blood-brain barrier.

Feedback

A. Incorrect!
The spaces between the endothelial cells of blood vessels in the brain are smaller and, therefore, less permeable.

B. Correct!
The blood-brain barrier is decreased or reduced in a few key locations in the brain, including: portions of the hypothalamus, capillaries in the pineal gland, and the membranous roof of both the third and fourth ventricles.

C. Incorrect!
The blood-brain barrier is reduced in the following regions: portions of the hypothalamus, capillaries in the pineal gland, and the membranous roof of both the third and fourth ventricles.

D. Incorrect!
The blood-brain barrier permits the passage of small hydrophobic molecules, such as oxygen, to enter the brain tissue.

E. Incorrect!
Surrounding the tightly-packed endothelial cells of the brain's blood vessels are glial cells and, together, they make up the blood-brain barrier.

Solution

The spaces between the endothelial cells that line the capillaries throughout the body allow for drugs to pass between the cells to enter most organs. In the brain, the capillaries are lined with tightly-packed endothelial cells and a layer of glial cells; this is known as the blood-brain barrier. This protective barrier allows the entry of small hydrophobic molecules, such as oxygen and carbon dioxide. It is very selective for the drugs that can pass into the brain. This barrier is decreased or reduced in a few key locations in the brain, including: portions of the hypothalamus, capillaries in the pineal gland, and the membranous roof of both the third and fourth ventricles.
Which statement about the group of central white matter identified in the image below is correct?

A. The central white matter identified in the image connects the two hemispheres of the brain.
B. The projection fibers are identified in the image above.
C. An association fiber is identified in the image.
D. The white matter group identified in the image extends into the medulla oblongata.
E. The central white matter surrounds the gray matter deep in the brain.

Feedback

A. Correct!
The corpus callosum is identified in the image, and it connects the two hemispheres of the brain.

B. Incorrect!
The projection fibers link the cerebrum with other regions of the brain and the spinal cord.

C. Incorrect!
The association fibers interconnect tracts in the same hemisphere; the corpus callosum is identified in the image.

D. Incorrect!
The central white matter identified in the image extends from one hemisphere to the other.

E. Incorrect!
The gray matter surrounds the central white matter.

Solution

Within the gray matter of the cerebral cortex is the central white matter. These bundles of myelinated axons include the following groups of fibers: (1) association fibers – interconnecting tracts between the different areas, within a single hemisphere, (2) commissural fibers – connect the two cerebral hemispheres. The prominent commissural bundles make up the corpus callosum, where information crosses over from one hemisphere to the other. (3) projection fibers – link the cerebrum with other regions of the brain and spinal cord.
A 61-year-old male is sent for brain surgery to remove a tumor growing within the region of his brain that makes up the limbic system. As a function of the operation, the fornix must be ablated and rendered non-functional. Based on this information, which of the following is correct?

A. The fornix is located in the occipital lobes of the brain.
B. The fornix is made up of the cingulate gyrus and the dentate gyrus.
C. The function of the fornix is to connect the hippocampus and the hypothalamus.
D. Overall, the limbic system, which the fornix is part of, has no role in memory.
E. The fornix and the limbic lobe are the two components of the limbic system.

A. Incorrect!
The fornix is part of the limbic system and is located between the hippocampus and the hypothalamus.

B. Incorrect!
The cingulate gyrus and the dentate gyrus are part of the limbic lobe.

C. Correct!
The fornix is a white matter tract that connects the hippocampus and the hypothalamus.

D. Incorrect!
The limbic system is involved in emotion, behavior and memory.

E. Incorrect!
The limbic system includes: (1) amygdaloid body, (2) limbic lobe, (3) fornix and the (4) mamillary bodies.

The limbic system involves a number of structures and functions to produce emotion, behavior, and memory. The structures involved in this system include: (1) amygdaloid body – functions to integrate the limbic system, the cerebrum, and various sensory systems, (2) limbic lobe – made up of the cingulate gyrus, dentate gyrus and the parahippocampal gyrus, (3) fornix – a white matter tract that connects the hippocampus and the hypothalamus, (4) mamillary bodies – contain motor nuclei that are involved in the control of reflex movements associated with eating and swallowing.
Question No. 9 of 10

Instructions: (1) Read the problem statement and answer choices carefully, (2) Work the problems on paper as needed, (3) Pick the answer, and (4) Review the core concept tutorial as needed.

Which of the statements is correct about the region of the brain identified with the red oval in the image below?

A. This is the brain stem.
B. The brain stem is identified in the image, and it includes the hypothalamus, mesencephalon, pons and medulla oblongata.
C. The diencephalon is identified in the image above.
D. This area of the brain contains a single colliculus on either side of the brain.
E. There is no respiratory center or cardiac center in this region of the brain.

A. Correct!
The red oval in the image above is identifying the regions that make up the brain stem: mesencephalon, pons and medulla oblongata.

B. Incorrect!
The hypothalamus is part of the diencephalon, not the brain stem.

C. Incorrect!
The diencephalon is superior to the mesencephalon portion of the brain stem.

D. Incorrect!
Within the region identified in the image, there is a superior and inferior colliculus on either side of the brain.

E. Incorrect!
There is a respiratory center in the pons and the medulla oblongata, as well as a cardiac center in the medulla oblongata.

Solution
There are 12 pairs of cranial nerves that connect the brain and the peripheral nervous system. The cranial nerves perform a variety of functions, including transmitting sensory information, as well as delivering motor commands. Which of the following statements about the cranial nerves is correct?

A. The 7th cranial nerve is the facial nerve.
B. The trigeminal nerve is the 11th cranial nerve.
C. The abducens nerve specifically innervates the superior oblique muscle of the eye.
D. The 10th cranial nerve is the vagus nerve and its origin for the sensory function is from the posterior portion of the tongue.
E. The olfactory nerve has its origin in the retina of the eye.

A. Correct! The facial nerve is the 7th cranial nerve.
B. Incorrect! The trigeminal nerve is the 5th cranial nerve.
C. Incorrect! The abducens nerve specifically innervates the lateral rectus muscle of the eye.
D. Incorrect! The vagus nerve is the 10th cranial nerve; however, its origin for the sensory function is from the pharynx and the diaphragm.
E. Incorrect! The origin of the olfactory nerve is the receptors of the olfactory epithelium.